

DOCUMENT RESUME

ED 430 992

TM 029 818

AUTHOR Wang, Jianjun; Turner, Dianne
TITLE A Structural Model of Student Career Aspiration and Science Education: The 10th Grade Investigation.
PUB DATE 1999-04-00
NOTE 27p.; Paper presented at the Annual Meeting of the American Educational Research Association (Montreal, Quebec, Canada, April 19-23, 1999).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Career Planning; Family Environment; Grade 10; *High School Students; High Schools; Instructional Effectiveness; *Outcomes of Education; Personality Traits; *Productivity; *Science Education
IDENTIFIERS Longitudinal Study of American Youth; *Structural Modeling

ABSTRACT

Career aspiration is an important factor articulating student academic preparation and career orientation. On the basis of H. Walberg's educational productivity theory, 10th grade national data from the Longitudinal Study of American Youth have been analyzed to examine structural relations between educational productivity and career aspiration in the context of science education. The data were split into odd- and even-numbered halves, and strong correlations were reconfirmed among factors of educational outcome, motivation, instructional quality and quality, and home and peer environments. In addition, empirical links are found between these factors and student career aspiration. The statistical results are interpreted in terms of contextual information in broad aptitude-attributes, instructional characteristics, and psychological environment categories. (Contains 2 figures, 3 tables, and 29 references.) (Author/SLD)

* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

Running Head: Career Aspiration & Science Education

**A Structural Model of Student Career Aspiration and Science Education:
The 10th Grade Investigation**

Jianjun Wang
Dianne Turner
Department of Teacher Education
California State University, Bakersfield
9001 Stockdale Highway
Bakersfield, CA 93311-1099
Phone: (805) 664-3048
Fax: (805) 664-2199
E-Mail: jwang@academic.csubak.edu

U.S. DEPARTMENT OF EDUCATION
(Office of Educational Research and Improvement)
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

- ☒ This document has been reproduced as received from the person or organization originating it.
- ☐ Minor changes have been made to improve reproduction quality.
- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND
DISSEMINATE THIS MATERIAL
HAS BEEN GRANTED BY

Jianjun Wang

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)

Paper presented at the 1999 AERA annual meeting in Montreal, Canada.

**A Structural Model of Student Career Aspiration and Science Education:
The 10th Grade Investigation**

Abstract

Career aspiration is an important factor articulating student academic preparation and career orientation. On basis of Walberg's educational productivity theory, 10th grade national data from the Longitudinal Study of American Youth (LSAY) have been analyzed to examine structural relations between educational productivity and career aspiration. The data were split into odd- and even-numbered halves, and strong correlations have been reconfirmed among factors of educational outcome, motivation, instructional quantity, as well as home and peer environments. In addition, empirical links are found between these factors and student career aspiration. The statistical results are interpreted in terms of contextual information in broad aptitude-attributes, instructional characteristics, and psychological environment categories.

**A Structural Model of Student Career Aspiration and Science Education:
The 10th Grade Investigation**

Under pressure of the global market competition, student career orientations increasingly rely on many factors of education, particularly those related to science teaching. The National Research Council (1996) pointed out:

A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning. And the economic productivity of our society is tightly linked to the scientific and technological skills of our work force. (p. ix)

Limited by the amount of academic training, non-college bound students are a special group of the labor force facing severe difficulties in school-to-work transition. Halperin, Melaville, and Taylor (1988) observed, "Youth today, especially those who do not go to college, find it increasingly difficult to match changing market demands" (p. 7-8). While few educators are able to extend the number of years in school, enhancement of educational productivity may help strengthen student academic preparation. The purpose of this article is to examine the relationship between career aspiration and contextual factors of science teaching. Clery, Lee, Knapp, and Carroll (1998) noted, "For both men and women, education was positively associated with work consistency after leaving school" (p. 15). Accordingly, this empirical investigation is focused on analyses of a national data base to confirm relations among factors of student career aspiration and educational productivity. The results may help nurture career aspiration and facilitate school-to-work transition for non-college bound students.

Literature Review

School-to-work transition has been a sustained problem attracting attention of the U.S.

policy makers and educators. Decker (1997) reviewed that "over the past 30 years, a substantial proportion of high school graduates and dropouts were unemployed shortly after leaving high school" (p. 6). While solution to this problem hinges on many factors, part of the concern has been centered on quality of secondary education. Meyer and Wise (1982) highlighted:

A large number of young persons enter the labor force immediately upon graduation from high school. Many receive no further formal education. For these youths, as well as those who continue their education, high school preparation is a potentially important determinant of early labor force experience. (P. 277-278)

In general, high schools in the U.S. have four grade levels, and not all of them carry the same weight on student academic training. Whereas 9th and 12th grades may endure distractions from the school entrance and graduation, 10th and 11th grades are relatively stable stages with a major focus on academic training. Nonetheless, few national projects have set a base-line study at the 11th grade level (Davis, & Sonnenberg, 1995). Thus, 10th grade is one of the few grade levels which has sufficient data to support an empirical investigation on issues of school-to-work transition. In addition, according to The Condition of Education 1996, "Dropouts from the 1990 sophomore class were more likely to return to school than were their counterparts a decade earlier" (Smith, et al., 1996, p. 50). Hence, proper guidance is needed at the sophomore level to smooth the transition between school and work place. In this study, 10 grade data have been selected from relevant national projects, and the statistical analyses are focused on relations between student career aspiration and educational productivity.

Data Selection

Since the early 1970s, the National Center for Education Statistics (NCES) has been

gathering longitudinal information on non-college bound student school-to-work transition.

To date, national data were released from three projects, the National Longitudinal Study of the High School Class of 1972 (NLS-72), the High School and Beyond (HS&B), and the National Education Longitudinal Study of 1988 (NELS:88). The 10th grade investigation has been covered in HS&B and NELS:88. Davis and Sonnenberg (1995) outlined:

The two studies that preceded NELS:88 (the National Longitudinal Study of 1972/NLS-72 and High School and Beyond/HS&B) surveyed high school senior (and sophomores in HS&B) through high school, postsecondary education, and work and family formation experiences. ... NELS:88 seeks to expand on this base of knowledge by following young adolescents starting at an earlier age (8th grade) and by updating information throughout the 1990s. (p. 81)

Hoffer (1988) concurred that "While High School and Beyond also collected information on these topics, NELS88 is more comprehensive" (p. 4).

In the late 1980s, the National Science Foundation funded another longitudinal project, the Longitudinal Study of American Youth (LSAY). Like NELS:88, the LSAY project was built on the experience from previous longitudinal surveys. Suter (1992) observed that "efforts were made by the LSAY research team to include items from both NLS-72 and HS&B" (p. 131). In comparing the differences, Hoffer (1988) noted: "Whereas NELS88 is a multipurpose project seeking to collect data relevant to a wide range of policy issues, the LSAY is focused on science and math education and how educational experiences affect students' attitudes, interests, and career decisions" (p. 6). In addition, Hoffer (1988) delineated:

The NELS88 cognitive tests, for example, included only about half the number of items in the LSAY. And the LSAY attitudinal batteries included at least two and usually three items for each dimension, while the NELS88 batteries have only one item for each dimension. In general, then, the LSAY should measure these dimensions with greater reliability, and the measure should prove more useful for analyses of change over time. (p. 11-12)

Therefore, the LSAY data contained more variables of science education than the other longitudinal studies.

In 1987, the LSAY researchers started the longitudinal investigation at the 10 grade level, and collected abundant information on student career planning. According to Miller and Brown (1992), "Results of the LSAY data analyses permit an understanding of the relative importance of the factors constituting a model to predict the development of career expectations" (p. 221). On the other hand, Walberg and his colleagues have employed the LSAY data to reconfirm a theory of educational productivity (Reynolds & Walberg, 1991, 1992; Young, Reynolds, & Walberg, 1996). Hence, the 10th grade data from LSAY were adopted in this study to examine relations between career aspiration and productivity factors in science teaching.

A Theory of Educational Productivity

In the United States, public schools were mainly supported by tax dollars, and thus, educational productivity was demanded by the American public. Fraser, Walberg, Welch, and Hattie (1987a) noted that "the public ranks research on educational productivity higher in priority than most other fields of scientific investigation in the other natural and social sciences" (p. 149).

Among the existing research on educational productivity, Walberg (1981, 1986) proposed a nine-factor theory through synthesizing several thousand investigations. Reynolds and Walberg (1991) elaborated:

The nine productivity factors can be divided into three sets. First, the student aptitude-attributes set includes (a) student ability or prior achievement, (b) motivation, and (c) developmental level (e.g., age). Second, the instruction set is indexed by its (d) quantity (or amount of time) and (e) quality (or appropriateness) for the student. The third set, psychological environment, includes (f) class environment, (g) the stimulating qualities of the home environment, (h) peer environment, and (i) exposure to mass media,

particularly television, outside of school. (p. 97)

The theory was subject to empirical reconfirmations since the early 1980s. Young, Reynolds, and Walberg (1996) recollected:

The theory has guided the compilation of more than 120 research syntheses of 8,000 comparisons in small-scale experimental and correlational studies (Fraser, Walberg, Welch, & Hattie, 1987) and 23 regression analyses of achievement obtained from (mostly national) surveys of about 250,000 students in six subjects of primary and secondary school study (Paschal & Starhia, 1992). (p. 272)

According to Ralph W. Tyler (1984), the forefather of educational assessment,

Herbert Walberg has done a superior interpretation of one of the most massive collections of data on school learning. He avoids the common weaknesses of many statistical reports; he recognizes the complexity of much human learning and does not try to reduce it to a simplistic model; he discusses the meaning of the data as well as indicating the quantitative results; he does not confuse statistical significance with substantive or social significance; he seeks to explain interactions among variables in common-sense terms; and he examines and reports both macro studies and micro studies. (p. 27)

During the last decade, substantial progress has been made on the statistical methods employed in theory reconfirmation. In the early 1980s, a widely used method was the ordinary least squares regression. Reynolds and Walberg (1991) reviewed:

Such analyses are useful in probing causal hypotheses and ruling out rival causes (Mosteller & Tikey, 1977), but they do not control for reverse and joint effects. Nor do they take account of measurement error, relationships among predictor variables, and unequal interval scaling of independent and dependent variables. For better estimates of effects, structural modeling is necessary. (p. 98)

Structure equation modeling is a comprehensive statistical approach to constructing relations among indicator variables and latent factors (Hoyle, 1995). Researchers demonstrated that even for models of the same structure, indicators of a latent factor can still be chosen differently, resulting in different estimates of structural relations (e.g., Reynolds & Walberg, 1991, 1992). Since the entire LSAY data contain more than 8,000 variables, individual

investigators may be perplexed by the overwhelming amount of information. Fortunately, the LSAY researchers constructed a set of composite variables to enhance the information coverage on student aptitude-attributes, instructional characteristics, and psychological environment (Miller, et al., 1992). The composite variables have been included in an LSAY CD-ROM disk (Chicago Academy of Sciences, 1995). Hence, empirical relations identified in this study can be verified by other researchers through secondary analyses.

In summary, Walberg's model of educational productivity presented a theoretical framework guiding the study of relations between educational productivity and students' career aspiration. In the 1990s, the LSAY data have been chosen by Walberg and other researchers to develop structural equation models (Reynolds & Walberg, 1991, 1992; Young, Reynolds, & Walberg, 1996). Reynolds and Walberg (1991) noted, "structural modeling can account for measurement error, determine construct validity of measures, and test model fit, none of which can be handled by classical regression analysis" (p. 98). Hence, this study was designed to construct a structural model according to Walberg's theory, and confirm the model through the LSAY data analyses.

Research Questions

Wilson (1996) pointed out, "The unemployment rates among both low-skilled men and women are five times that among their college-educated counterparts" (p. 28). Under an assumption that factors of educational productivity may influence student career orientation, research questions that have been analyzed in this study are:

1. What are the relations between factors of educational productivity and student career

aspirations?

2. Is the career aspiration model strongly supported by the LSAY data base?
3. How to interpret the empirical findings in a broad education context?

Methods

In the LSAY project, students were asked about their first choice for the future occupation. The answer was scaled on a social economic index (Stevens & Cho, 1985; Stevens & Featherman, 1981), and released in the LSAY public data base (Miller, Hoffer, Suchner, Brown, & Nelson, 1992). Meanwhile, the career utility of science training was assessed by a Likert scale item in LSAY. The variable codes were reversed positively with 1 representing "no use" and 5 representing "very useful". Thus, career aspiration was empirically identified by the two indicator variables, the expected occupation and the career utility of science (Table 1).

On the other hand, the original Walberg's theory contained nine productivity factors which were postulated to influence career orientation. In an analysis of the LSAY data for disentangling educational productivity, Reynolds and Walberg (1992) reported that "Because the students in the sample were all from the same grade level, age was relatively constant and therefore omitted" (p. 373). This observation was conformed in this LSAY data analysis. Consequently, construction of the structural model was based on the remaining eight factors of educational productivity (Table 1).

Table 1 inserted around here

Indicators of the productivity factors were selected from composite variables developed

by the LSAY researchers (Miller, et al., 1992; Miller & Brown, 1992). Each composite variable was based on multiple items in the LSAY survey instrument. The use of multiple sources of information was recommended by many researchers to reduce potential measurement errors (e.g., Bentler, 1980; Hayduk, 1987; Reynold & Walberg, 1991). To facilitate the model verification, correspondence between the composite indicators and the latent factors was presented in Table 1.

According to Reynolds and Walberg (1991), factors of educational productivity can be classified in three categories. The first category was student aptitude-attribute which has been represented by education outcome and student motivation. Education outcomes have been assessed by students' achievement in and attitude toward science. The achievement test was composed by items developed for the National Assessment of Educational Progress (NAEP). The attitude battery assessed student feeling about science, self-esteem, and persistence in science learning (Miller, et al., 1992).

The second category of educational productivity is instructional quality and quantity. Walberg and his colleagues used weekly homework hours as an indicator of the instructional quantity (Young, Reynolds, & Walberg, 1996). However, they did not study the relationship with student career preparation. Besides the homework indicator, LSAY researchers collected information on school work ethics to reflect student intrinsic effort on school work. The two variables, the hours of weekly homework and the level of school work ethics, have been chosen in this study to reflect the quantity of instruction. On the other hand, the instructional quality was identified by a composite LSAY variable on science teachers' academic push. Specifically, the variable was composed from student reports on encouragement of teachers on various phases of the learning process (Miller, et al., 1992). All these factors have been surveyed at the

individual level, indicating instructional quality in secondary schools.

In the third category, psychological environment was split into home, class, peer, and media settings. The home environment was represented by parental education pushes and the family socioeconomic status. The class setting was reversely indicated by classmates' negative pressure on school success. The peer grouping was based on peer attitudes regarding academic achievement and science study. Finally, the media environment was represented by a composite variable of student news acquisition, which integrated student reports on utilization of news magazine, newspaper, and TV news (Miller, et al., 1992). Since not all the items were measured on the same scale, the selected indicators were standardized to eliminate influences from the confounding scale calibration.

According to Reynolds and Walberg (1991), "The Walberg productivity model posits direct, simultaneous influences of the nine factors on outcomes" (p. 9). Accordingly, direct structural relations were postulated between the productivity factors and student career aspiration (Figure 1).

Figure 1 inserted around here

In addition, correlations among the productivity factors were accommodated in this model. The LISREL8 software was employed to estimate structural parameters among the standardized latent factors. Reynolds and Walberg (1991) pointed out:

A major strength of LISREL is its latent-variables approach to model testing, whereby multiple indicators of each factor are obtained. ... Also, LISREL provides the following features for model testing: full information maximum likelihood estimation, statistical

assessments of model fit and indications for improving the model, and relaxation of classical regression assumptions (i.e., no measurement error, no error term correlations), which are often unrealistic with dynamic models, non-recursive structural models, and estimation of polychoric and polyserial correlation. (p. 100)

In 1987, approximately 3000 tenth grade students were selected randomly in LSAY and followed twice yearly for more than five years (Chicago Academy of Sciences, 1995). Like in most large-scale survey studies, missing values must be handled with proper caution. To construct the correlation matrix among indicator variables, pairwise deletion was adopted in the data cleaning. The minimum number of observations among all identified variables was 2193, above 73% of the sample size. To facilitate the model reconfirmation, the achieved sample is split into even- and odd-numbered halves. Cases in the odd-numbered half are employed to develop a structural equation model, and the even-numbered half is adopted to cross-validate the findings between career preparation and educational productivity. To guard against potential type I errors in statistical testing, the minimum sample size is used in the LISREL program for parameter estimation.

Results

Career aspiration is a psychological outcome depending on factors of educational productivity. Parameters describing its direct links with factors of education productivity were estimated by the maximum likelihood method and presented in Figure 2. Because the LSAY data have been split into two halves, results on the even numbered half were enclosed within boxes (Figure 2). Data in the odd-numbered half converged to the results after 38 iterations, while the even-number half completed the convergence in 49 iterations.

Figure 2 inserted around here

Correlations among the productivity factors were listed in Table 2.

Table 2 inserted around here

For each productivity factor, factor loadings were calculated to reflect the contribution of the LSAY composite variables on the latent factor construction (Table 3).

Table 3 inserted around here

The standardized root mean square residual (RMR) for the model was 0.05, and the goodness-of-fit index (GFI) was 0.94. Both the low RMR and high GFI values suggested a good fit of the LSAY data for the structural equation model (Joreskog & Sorbom, 1993). Since the model described relations between eight productivity factors and the expected occupation, interpretation of the model structure has been accordingly directed toward the condition of science teaching and career aspiration.

Discussions

In the research literature, factors of educational productivity have been classified into aptitude-attribute, instructional characteristics, and psychological environment domains (Reynolds & Walberg, 1991). However, correlations within each domain were not consistently

higher than that across the domains (Table 2). For instance, student peer grouping was typically formed in a local community, and thus, a strong correlation has been found between the peer and home environments. On the other hand, the instructional quantity factor was indicated by the amount of homework completed by students. It was found that the home and peer influences have been strongly linked to instructional quantity. These correlation coefficients were much larger than those for the media and class environments (Table 2).

Educational attainment and motivation were highly correlated, but their correlations with other factors were primarily rested on factors of instructional quantity, and the peer and home environments (Table 2). These results seemed to suggest that students were located at center of the learning process. At the student level, the learning activities may be supported by parents, influenced by peers, and strengthened through a proper amount of school work. All these features contributed to enhancement of student motivation and education attainment. Consequently, these contextual articulations have resulted in high correlations among this cluster of factors.

In contrast, other productivity factors were less focused on students. Specifically, the quality of instruction was mainly reflected by teachers' behaviors, the class environment was grounded on school culture, and the media influence largely hinged on interest of the news agencies (Miller, et al., 1992). The separation among different parties may partly account for the relatively small correlations among these factors.

Compared to the class environment, instructional quality and media environment had stronger links to education attainment and motivation (Table 2). Perhaps, this was because the instruction and media factors were directly related to teachers' or parents' discretion. The class

environment factor, on the other hand, was represented by a composite LSAY variable describing students' fear of academic success in their classrooms. Miller, et al. (1992) elaborated:

The measure is based on agreement/disagreement with the following statements: in this school you are't very popular if you get better grades than other students (BA17C, HB23C); I worry that my success may make other students dislike me (BA17D, HB23D); I sometimes avoid discussing my accomplishments because other students might get jealous (BA17E, HB23E). (p. C2A-12)

This factor depended on school climates, as well as unguided interactions among students. Its weak correlations with other factors ($|r| \leq .05$) signified that this latent environment was self-contained with little influences from other factors. Thus, perhaps teachers and parents should make concerted effort to reach the student level, and encourage students to support each other in academic progress.

In Figure 2, the instructional quantity factor had a positive path coefficient toward career aspiration. This factor was represented by two LSAY variables, homework hours (AA27A) and students' school work ethic (SSHWE1) (Table 1). The ethic variable indicated effective use of student time, and had a higher factor loading than the homework hours (Table 3). In contrast, the instructional quality was described by the external teachers' push (SSCTCPH1) (Table 1), which had a weak link to student career aspiration (Figure 2). These findings seemed to indicate that encouraging student intrinsic effort was a more effective instructional strategy than the superficial amount of assignment and external push that teachers placed in the classroom.

Moreover, the positive path coefficient from the educational outcome factor was largely explained by the feature of its indicators. Table 1 showed that the educational outcomes were identified by students' achievement in and attitude toward science (ASCIIRT, SSCAT1). Smith, et al. (1996) noted:

Competence in science is an important outcome of education. The ability to apply scientific information, interpret data, and make inferences about scientific findings is useful in a world that relies heavily on technological and scientific advances. (p. 74)

Thus, the positive path coefficient reconfirmed the supportive role of science education in student career preparation.

The home environment is another factor with positive contributions to career aspiration (Figure 2). In this study, the home environment was represented by parental educational commitment and home social economic status (Table 1). Table 3 showed that the parental science and academic push (ASCPH1, PACPH1) had a larger factor loading than the family social economic status (SES3) while the weakest factor loading was located on parental college push (PCOPH1). This result seemed to confirm the importance of parental commitment to the non-college bound education, especially at the 10th grade level where the school goals were not completely set for higher education. Nonetheless, in reference to the weak media influence, the academic push needs to be further stressed (Figure 2). Otherwise, the parental influence would be merged within the general media environment which had little impact on student career aspiration.

The two other negative factors of the career aspiration were student motivation and peer environment (Figure 2). The motivation factor was indicated by two LSAY variables, student self-esteem (SSFES1) and independence/persistence in schooling (SIPPS1) (Table 1). Since most 10th grade students were in a process of establishing self-identity (Meeus, Geode, Kox, & Hurrelmann, 1992), it was possible that some students with less independence and unclear self-concepts might project their future jobs based on unrealistic dreams. The disagreement between students' perception and preparation has been documented in the research literature. For

instance, in the Third International Mathematics and Science Study (TIMSS), Beaton, Martin, Mullis, Gonzalez, Smith, and Kelly (1996) observed:

Career Aspiration & Science Education 17

In all except three countries, the majority of students agreed or strongly agreed that they did well in science or science subject areas - a perception that did not always coincide with the comparisons in achievement across countries on the TIMSS test. (p. 4)

Thus, the discrepancy between motivation and career preparation, seemed less likely for adults, was quite plausible for the adolescence.

On the other hand, peer environment was indicated by two composite scales, peer academic push (KACPH1) and peer science push (KSCPH1) (Table 1). It was noted in the LSAY codebook that,

Peer Academic Push - This scale measures student reported attitudes of their peers regarding academic achievement. The questions included are, my friends: plan to go to college, are good students, think that I am a good student. (Miller, et al., 1992, p. 53)
Peer Science Push - This scale measures student reported attitudes of their peers regarding science. The questions included are, My friends: like science, do well in science, hope to become scientists, doctors, engineers, or mathematicians, know how to write computer programs. (Miller, et al., 1992, p. 54)

Although the peer science push item portrayed a positive picture about the peer environment, its impact on students remained uncertain. For instance, even with good peers, the effect could be negative if the students relied on their peers for the school work.

Similarly, the peer academic push may reflect the peer influence in different contexts. The best circumstance could be that both students and their friends were good at school. The middle ground was that the peers were good but the student was not, or vice versa. The worst scenario was a bad student matched by bad peers. Again, this indicator did not always represent positive positive influence on student learning and career orientations.

In summary, while the LSAY data were found pertinent to a study of student career

aspiration and educational productivity (e.g., Miller & Brown, 1992; Reynolds & Walberg, 1991; 1992), few researchers have articulated investigations on both sides. Miller and Brown (1992)

Career Aspiration & Science Education 18

highlighted relevancy of the LSAY data to examination of student career preparations at the non-college bound level. On the other hand, Walberg and his colleagues analyzed the LSAY data to reconfirm a structural model of educational productivity (Reynolds & Walberg, 1991; 1992).

These existing studies have been integrated in this investigation to develop structural relations articulating factors of educational productivity and career aspiration. According to the empirical model, students were found at center of the learning process. Contextual factors less relevant to student learning activities had weak correlations with education outcomes. More specifically, it was found that more concerted effort may be needed to establish a positive class environment which encouraged student academic progress. The enhancement of educational attainment, instructional quantity, and parental academic push were directly linked to improvement of student career aspiration. These findings were confirmed by both odd- and even-halves of the LSAY data with a high goodness-of-fit index ($GFI=0.94$). However, interpretations on the negative path coefficients have been far from conclusive. Fraser, Walberg, Welch, and Hattie (1987b) pointed out, "Research workers and educators should retain both open-mindedness and skepticism about educational productivity and syntheses of research" (p. 164). Continued investigation of the model with different data and indicators will likely produce findings to triangulate results of this empirical inquiry, and provide more insight on articulation of factorial relations behind school-to-work transition.

References

- Beaton, A., Martin, M., Mullis, I., Gonzalez, E., Smith, T. & Kelly, D. (1996). Science achievement in the middle school years. Chestnut Hill, MA: Boston College.
- Bentler, P. (1980). Multivariate analysis with latent variables: Causal modeling. Annual Review of Psychology, 31, 419-456.
- Chicago Academy of Sciences (1995). Longitudinal Study of American Youth: Base year through year 5. Chicago, IL: The International Center for the Advancement of Scientific Literacy and The Chicago Academy of Sciences.
- Clery, S. B., Lee, J. B., Knapp, L. G., & Carroll, C. D. (1998). Gender differences in earnings among young adults entering the labor market. Washington, DC: U.S. Department of Education.
- Davis, C. & Sonnenberg, B. (1995). Programs and plans of the National Center for Education Statistics. Washington, DC: U.S. Department of Education.
- Decker, P. (1997). Findings from education and the economy: An indicators report. Washington, DC: U.S. Department of Education.
- Fraser, B., Walberg, H., Welch, W., & Hattie, J. (1987a). The need for educational productivity research. International Journal of Educational Research, 11 (2), 147-154.
- Fraser, B., Walberg, H., Welch, W., & Hattie, J. (1987b). Syntheses of research on factors influencing learning. International Journal of Educational Research, 11 (2), 155-164.
- Halperin, S., Melaville, A., & Taylor, A. (1988). The forgotten half: Non-college youth in America. Washington, DC: The William T Grant Foundation Commission on Work, Family and Citizenship.

- Hayduk, L. (1987). Structural equation modeling with LISREL: Essentials and advances. Baltimore, MD: Johns Hopkins University Press.
- Hoffer, T. B. (1988, April). The Longitudinal Study of American Youth and the National Education Longitudinal Study of 1988: a comparison. Paper presented at the annual meeting of American Educational Research Association, New Orleans, LA.
- Hoyle, R. (1995). Structural equation modeling. Thousand Oaks, CA: Sage.
- Joreskog, K. & Sorbom, D. (1993). LISREL8 user's reference guide. Chicago, IL: Scientific Software International.
- Meeus, W., Geode, M., Kox, W., & Hurrelmann, K. (1992). Adolescence, Careers, and Cultures. New York, NY: Walter de Gruyter.
- Meyer, R., & Wise, D. (1982). High school preparation and early labor force experience. In R. Freeman and D. Wise (eds.), The youth labor market problem: Its nature, causes, and consequences. Chicago, IL: The University of Chicago.
- Miller, J. & Brown, K. (1992). The development of career expectation by American youth. In W. Meeus, M. Goede, W. Kox, and K. Hurrelmann (Eds.), Adolescence, Careers, and Cultures. New York, NY: Walter de Gruyter.
- Miller, J., Hoffer, T., Suchner, R., Brown, K., & Nelson, C. (1992). LSAY codebook. DeKalb, IL: Northern Illinois University.
- National Research Council (1996). National science education standards. Washington, DC: National Academy Press.
- Reynolds, A. J. & Walberg, H. J. (1991). A structural model of science achievement. Journal of Educational Psychology, 83 (1), 97-107.

- Reynolds, A. J. & Walberg, H. J. (1991). A structural model of high school science outcomes. Journal of Educational Research, 85 (3), 150-158.
- Smith, T., Young, B., Choy, S., Perie, M., Alslam, N., Rollefson, M., & Bac, Y. (1996). The condition of education 1996. Washington, DC: the U.S. Government Printing Office.
- Stevens, G. & Cho, J. (1985). Socioeconomic indexes and the new 1980 census occupational classification scheme. Social Science Research, 14, 142-168.
- Stevens, G. & Featherman, D. (1981). A revised socioeconomic index of occupational status. Social Science Research, 10, 364-395.
- Suter, L. E. (1992). Indicators of science and mathematics education 1992. Washington, DC: National Science Foundation.
- Tyler, R. W. (1984). A guide to educational trouble-shooting. Educational Leadership, 41 (8), 27-30.
- Walberg, H. (1981). A psychological theory of educational productivity. In F. H. Farley and N. Gorden (Eds.), Psychology and education. Berkerley, CA: McCutchan.
- Walberg, H. (1986). Synthesis of research on teaching. In M. C. Wittrock (Ed.), Handbook of research on teaching (3rd ed.). Washington, DC: American Educational Research Association.
- Wilson, W. (1996). When work disappears. New York, NY: Alfred A. Knopf.
- Young, D., Reynolds, A., & Walberg, H. (1996). Science achievement and educational productivity: A hierarchical linear model. Journal of Educational Research, 89 (5), 272-287.

Table 1

Description of latent factors and the corresponding LSAY variables

Productivity Factor	LSAY Variable	Description
Career Inspiration	AA22AS AASCI1F	SEI of the expected occupation career utility of science class
Education outcome	ASCIIRT SSCAT1	student science achievement student attitude toward science
Motivation	SIPPS1 SSFES1	student independence & persistence student self-esteem
Instructional quantity	AA27A SSHWE1	student report of homework hours student school work ethic
Instructional quality	SSCTCPH1	science teacher academic push
Home environment	PSCPH1 PACPH1 PCOPH1 SES3	parental science push parental academic push parental college push family socioeconomic status
Class environment	SFESX1	student's fear of success in class
Peer environment	KSCPH1 KACPH1	peer science push peer academic push
Mass media	SNWAQ1	student news acquisition

Table 2

Correlations of the productivity factors in the structural equation model

Factor Domains	<u>Aptitude-Attribute</u>		<u>Instruction</u>		<u>Psychological Environment</u>			
	ed outcome	motivation	quantity	quality	home	class	peer	media
<u>Odd-ID Half</u>								
ed outcome	1.00							
motivation	0.64	1.00						
.....								
quantity	0.41	0.67	1.00					
quality	0.29	0.17	0.21	1.00				
.....								
home	0.49	0.56	0.45	0.32	1.00			
class	-0.02	0.01	-0.01	0.01	0.05	1.00		
peer	0.47	0.50	0.72	0.31	0.65	0.01	1.00	
media	0.19	0.33	0.24	0.07	0.28	-0.03	0.36	1.00
<u>Even-ID Half</u>								
ed outcome	1.00							
motivation	0.75	1.00						
.....								
quantity	0.48	0.72	1.00					
quality	0.31	0.26	0.28	1.00				
.....								
home	0.52	0.46	0.45	0.41	1.00			
class	0.00	0.05	0.05	-0.03	-0.02	1.00		
peer	0.54	0.55	0.69	0.21	0.73	-0.01	1.00	
media	0.25	0.32	0.27	0.15	0.31	0.01	0.35	1.00

Table 3

Description of latent factors and the corresponding loadings of the LSAY variables

Factor	LSAY Variable	Factor Loading	
		Odd-ID Half	Even-ID Half
Career Orientation	AA22AS	0.36	0.36
	AASCI1F	0.54	0.56
Education outcome	ASCI1RT	0.41	0.38
	SSCAT1	0.81	0.77
Motivation	SIPPS1	0.54	0.53
	SSFES1	0.44	0.42
Instructional quantity	AA27A	0.44	0.36
	SSHWE1	0.64	0.59
Instructional quality	SSCTCPH1	1.00	1.00
Home environment	PSCPH1	0.62	0.62
	PACPH1	0.49	0.47
	PCOPH1	0.29	0.36
	SES3	0.41	0.39
Class environment	SFESX1	1.00	1.00
Peer environment	KSCPH1	0.53	0.62
	KACPH1	0.68	0.66
Mass media	SNWAQ1	1.00	1.00

Figure 1

A Structural Model of Student Education and Career Aspiration

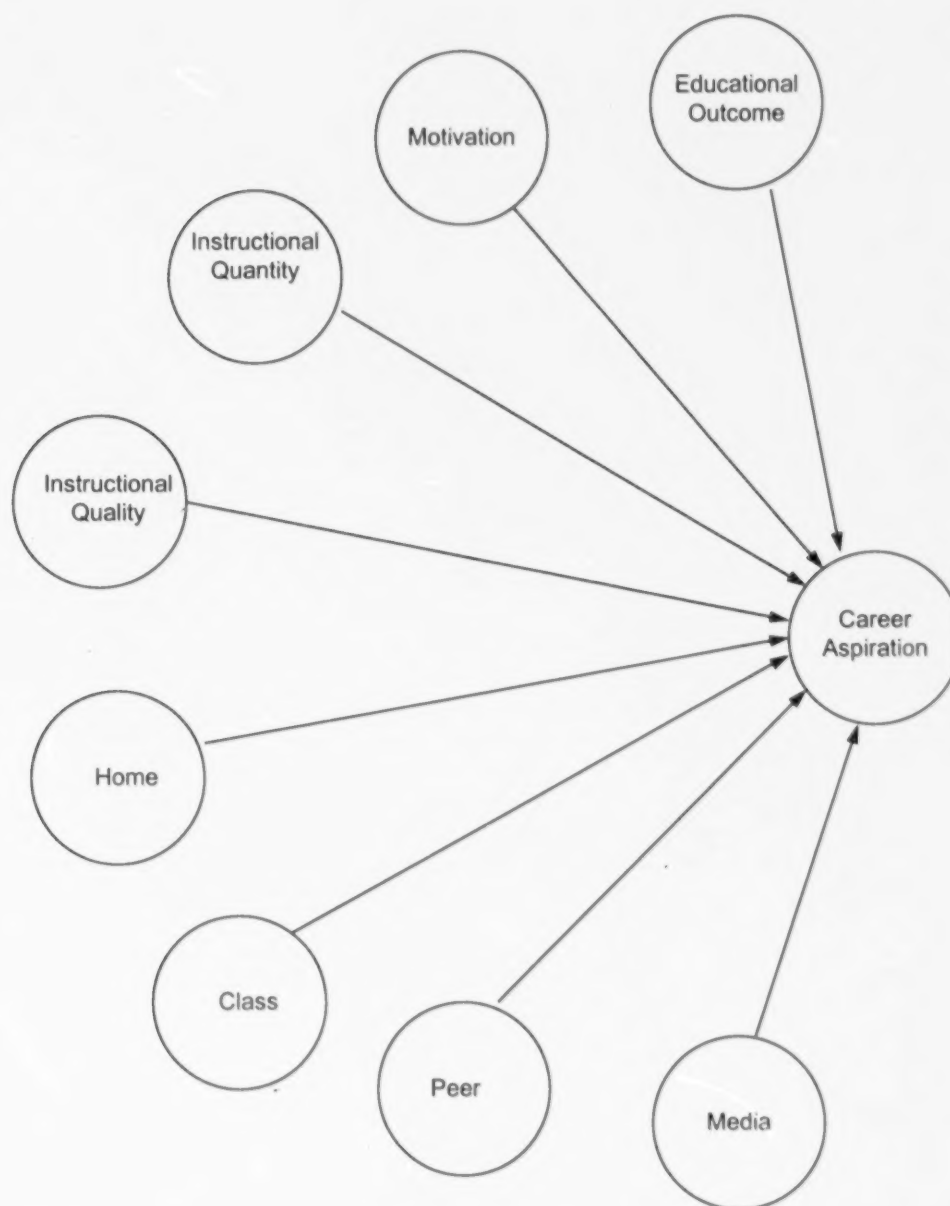


Figure 2

Parameters Describing the Direct Effects of Educational Productivity on Career Aspirations

